Chapter 2
General Considerations for Project Development

2-1. General

This chapter provides an overview of the engineering, policy, and planning guidance applicable to developing a project plan for navigation improvements associated with the planning, design, construction, and major rehabilitation of navigation locks.

a. Project team. The planning, engineering layout, and design of navigation locks as part of the overall development of a project plan for navigation projects is a complex, multidisciplinary planning and engineering effort. This effort involves the contributions from many public and private interests including local, state, and federal agencies; planners; design engineers; environmental engineers; natural habitat biologists; operations engineers; and construction engineers. It has been found through experience that the planning and design process works most efficiently if these participating interests work through a multidisciplinary planning-engineering team effort. In this effort, the project team receives and evaluates input to develop the project plan and recommendations for implementation. Thus, a project team should be organized at the initiation of the reconnaissance phase for a proposed navigation project. This team should include key personnel from planning, engineering, operations, construction, and project management. This project team should function through the entire life cycle of the project including planning, design, construction, and operation.

b. Navigation lock planning principles and guidelines. The objective of water resources planning is to contribute to national economic development (NED) consistent with protecting the environment of the United States, according to national environmental statutes, applicable executive orders, and other federal planning requirements. The planning process consists of the following steps:

(1) Problem identification. This step specifies the water and related land resources problems and opportunities associated with the federal interest in navigation concerns.

(2) Data gathering. Data gathering involves inventory, forecast, and analysis of water and land resource conditions within the planning area relevant to the navigation project problems and opportunities.

(3) Alternative studies. This step involves formulation and evaluation of the effects of the alternative plans. The NED plan reasonably maximizes net NED benefits, consistent with the federal objective. Other alternative plans should be developed to address other concerns not listed in the NED plan.

(4) Comparison of alternative plans. In this step, alternative plans and studies are compared in order to draw further conclusions.

(5) Recommendations. Based on conclusions, a recommended plan is selected and presented.

c. Design considerations during planning. During the planning stage, design considerations include issues of safety, efficiency, reliability, and cost effectiveness. Cost considerations should also incorporate the trade-off between initial cost and cost of operation and maintenance. The engineering guidance applicable to navigation project design is contained in ER 1110-2-1404, ER 1110-2-1457, and ER 1110-2-1458. Planning guidance specifies similar, but not identical, considerations for formulating alternative plans to identify the project that reasonably coordinates net benefits with environmental protection. Project optimization requires interaction between engineering, design, economic evaluation, and the environment. ER 1110-2-1150 specifies the engineering responsibilities for life-cycle cost optimization during studies and subsequent phases of project implementation. Coordination of design and evaluation relies on planning guidance and on the engineering and design services that are provided to the planning effort.

2-2. Evaluation of Existing Navigation Locks

a. General. The existing lock and dam structures in the inland navigation system are a vital link in the national infrastructure. However, over 40 percent of these facilities are more than 50 years old, and the demands for rehabilitation are increasing. While the infrastructure is deteriorating, navigation traffic is increasing, thus creating a demand for larger, more efficient facilities. Therefore, the limited funds available for rehabilitation must be selectively invested to maximize navigation benefits. Projects in a river system are usually about the same age and have similar lock capacity. Historically, rehabilitation work has concentrated on relieving local congestion. As these facilities approach or exceed their design life, future rehabilitation decisions must focus on identifying and reconstructing the project features which are declining in reliability or on modifying a major component to enhance operational efficiency.

b. Background. In the past, evaluations of existing structures have been based on deterministic analyses using current design criteria. Even with the adaptations permitted by ETL 1110-2-310, the current stability criteria are more stringent than criteria used in the design of many existing projects. Frequently, structures which have performed satisfactorily for years do not conform to current design criteria, indicating that current criteria alone should not be used to judge the reliability of existing structures.

c. Criteria. Engineering criteria are needed for the purpose of evaluating existing projects, and they may differ from those used for designing new projects. The criteria should account for uncertainties in the investigations, testing, material properties, and analyses used in the rehabilitation decision process. Reliability assessments, based on probabilistic methods, provide more consistent results that reflect both the basis for design and the condition of the existing structure. Reliability methods are the basis for new engineering criteria for designing bridges and steel buildings, as well as for prioritizing the maintenance and replacement of bridges.

d. Guidance. For the assessment of existing structures where new navigation facilities may be added, reliability assessments based on probabilistic methods will be used to determine the rehabilitation necessary for the existing structures. Additional guidance, background, and references relating to reliability assessment and condition analysis of structures are available from the references in Appendix A. Guidance is provided in ETL 1110-2-321 and ETL 1110-2-532 for assessing the reliability of navigation structures and establishing an engineering basis for rehabilitation investment decisions. As these procedures mature and the associated methodology is developed, further guidance will be issued.

2-3. Risk and Uncertainty -- Sensitivity Analysis

During the evolution of a navigation lock design, the amount of uncertainty and risk should be reduced as more information becomes available from the refined analysis and evaluation of alternatives. This process should refine the accuracy of the project cost estimate. Frequently, the amount of risk and uncertainty is underestimated or not even considered during preliminary stages of project formulation, and the project cost estimate increases as the design is refined. However, the baseline cost estimate must be developed during the feasibility phase when this information is still preliminary. Thus, engineering processes and their effects during the design phases should be examined to determine the uncertainty inherent in the data or various assumptions used in the engineering analysis and formulation of alternative plans. During development of the cost estimate, an engineering analysis should be formulated using the principles of risk and sensitivity analysis to estimate the appropriate contingencies to apply to the line item code of accounts. This procedure will ensure that the life-cycle project costs are established as a baseline for further design comparisons.

a. Uncertainty. In situations of uncertainty, potential outcomes cannot be described in objectively known probability distributions. The engineer's primary role in managing uncertainty is to identify the areas of sensitivity and clearly describe them so that decisions can be made on which parameters should be investigated in greater detail. For instance, during the feasibility stage for a navigation lock structure several sites may be under consideration; however, a foundation exploration program might be considered too expensive or time-consuming to define the foundation conditions for each of these sites. Thus, there may be a high degree of uncertainty of the founding elevation of the lock structures or the type of foundation required, pile or soil, which may have a high impact on the cost of the structures. Higher contingencies may be required for these line items to account for this degree of uncertainty. To reduce this uncertainty for a more determinate design, funds and time would have to be allocated to perform a foundation exploration and testing program for each site. Evaluation of the potential costs and benefits of alternative courses of action can aid in these investment decisions.

b. Risk. The potential outcome of risk situations can be described in reasonably well-known probability distributions such as the probability of particular flood events. For example, a risk analysis is necessary to determine the top of a cofferdam used to protect a navigation lock construction. The probability of overtopping the cofferdam at a certain elevation (cost of structure) can be compared to the damages associated with the frequency of flooding the cofferdam (cost of damages). This type of risk analysis can provide information for selecting the optimum height of cofferdam to minimize overall costs and/or time required for construction.

c. Reducing risk and uncertainty. Risk and uncertainty arise from measurement errors, lack of data, and the underlying variability of complex natural, physical, social, and economic situations. Reducing risk and uncertainty may involve increased engineering or construction costs or loss of benefits. The advantages and costs of reducing risk and uncertainty should be considered in the planning process. Additional information on risk and uncertainty can be found in Institute for Water Resources (IWR) Report 92-R-1 and ETL 1110-2-532.

d. Methods of dealing with risk and uncertainty. The following methods are required to calculate risk and uncertainty:

(1) Collecting more detailed data through physical explorations, research and development, and improved analytical procedures.

(2) Increasing safety factors in design.

(3) Selecting conservative alternative designs with known performance characteristics.

(4) Reducing the irreversible or irretrievable commitments of resources.

(5) Performing a sensitivity analysis of the estimated benefits and costs of alternative courses of action.

2-4. Environmental and Aesthetic Considerations

a. General. This section presents considerations for blending a lock structure into the surrounding environment for appearance, natural habitat, environmental quality, and public acceptance. Some important design considerations include requirements for aesthetics; dredging fill and disposal; hazardous, toxic, and radioactive wastes (HTRW); habitat; and citizen involvement through public hearings.

b. Architectural. Incorporating architectural appearance into project design, including consideration of the visual quality of the project, is an important objective for design of locks. Navigation structures are monumental and have a large impact on the landscape of the natural rivers. These structures are highly visible, and if public access is provided, will generate much visitor attraction. The following references provide guidance for enhancing the aesthetics of Civil Works projects: ER 1105-2-100, EM 1110-2-38, EM 1110-2-301, EM 1110-2-1202, EM 1110-2-1204, and EM 1110-2-1205.

c. Aesthetic design. The following principles should be applied in defining the appropriate measures for aesthetic enhancement at Civil Works projects in all stages of project development.

(1) Project relationship. Any project features must be related to blending the project into the project setting and not aimed at “beautifying” the surrounding area.

(2) Structures. Structures such as locks and dams, and accompanying buildings should have neat, clean lines and an uncluttered appearance. The plan for lock structures should account for aesthetic factors such as appearance, color, and landscaping, as well as incorporating safety features into the design. In addition, the plan should include the location of safety railings, fencing, machinery and equipment layouts, power and communication lines, and poles and appurtenances. Considerations for enhancing a structure’s appearance can range from selecting a material or color to using a specific type of railing. Architectural techniques and/or landscape plantings which may minimize the starkness of a structure can be used to create a visually pleasing appearance. The plans for the structure should incorporate artistic use of color, material selection, and texture and combinations. Also, including concrete finishes in the plans for the structure will improve its appearance to the general public. Machinery and other equipment can be located in architecturally pleasing structures or shrouds. In addition, consideration should be given to using concrete walls, parapets topped with railings, or metal railings instead of chain link fencing.

(3) Landscaping. Other unattractive areas can also be screened with landscape plantings. Landscape plantings must be limited to the land required for the project and plantings should not extend to adjacent property, even if the adjacent property is a public park or recreation area. All of these project considerations will allow the structures to blend with its surrounding environment.

(4) Project setting. The acceptability and compatibility of aesthetic features of project design are affected by the project setting and by the expectations of the users of the project. The land use in the area surrounding the project is an important consideration in determining the appropriate measures for aesthetics.

(5) Compatibility. All aesthetic measures must be designed so that they are fully compatible with the project purpose and in no way compromise the safety, integrity, or function of the project.

d. Hazardous, toxic, and radioactive wastes (HTRW).

(1) Site selection investigation. Prior to acquisition of any project lands, a site selection investigation should be conducted to determine if any HTRW violations exist on these lands. These investigations should search for the existence of any previous structures or land uses on that project site. Previous structures or uses which may

indicate potential environmental hazards include farms, gasoline stations, railroad yards, industrial plants, or military installations. If a real estate or title search indicates the existence of any installations which could result in HTRW, site studies should be initiated to determine if any HTRW exists. These evaluations should be a part of the reconnaissance phase and site-selection process.

(2) Reports. Results of the investigation should be covered in the reconnaissance and feasibility reports. These reports should include requirements for the HTRW restoration measures required before the land is acquired for project purposes.

e. Habitat.

(1) Protection of fish and wildlife. The planning stages of any project should incorporate a thorough study of the surrounding habitat for potential impact on the fish and wildlife.

(2) Construction considerations. Before initiating any project, engineers should account for the impact of construction activities on surrounding wildlife and infrastructure. The activities which may adversely affect the project area environment include the following:

(a) Noise control during pile driving or blasting.

(b) Control of rainwater or dewatering.

(c) Control of other fluid waste during construction.

(d) Disposal of excess dredge material.

(e) Erosion control during construction.

(3) Mitigation. When wetlands are removed or disturbed, a plan for mitigation must be developed.